



To: T10 Committee

From: Neil Wanamaker, PMC-Sierra (neil.wanamaker@pmcs.com)

Subject: SAT-4: Translation of ZBC->ZAC

Revision Information

R.0 15-005r0 (22 December 2014)

Initial Submission.

R.1 15-005r1 (6 January, 2015)

Correction of typographical errors.

Changed definition of RETURNED LOGICAL BLOCK ADDRESS to be consistent with RC_BASIS.

Changed usage of ALLOCATION LENGTH field of REPORT ZONES command.

R.2 15-005r2(9 March, 2015)

Removed definitions of ATA open/close/etc. commands.

Added definitions of host managed/aware devices, removed "ZAC device"

Restored READ CAPACITY parameter data to be as in SAT-3.

Update to be consistent with f14183r1 (style guide).

R.3 15-005r3 (21 April, 2015)

Updated with comments from March T10 CAP meeting.

R.4 15-005r~~4~~3 (8 May, 2015)

Updated with comments from May T10 CAP meeting.

R.5 15-005r5 (14 Sept, 2015)

Modified data returned in ZONED field of Block Device Characteristics VPD page, in response to comments from July T10 CAP meeting.

This version was accepted for incorporation in SAT-4 by the July 2015 T10 Plenary.

3 Definitions, symbols, abbreviations, and conventions

3.1 Definitions

3.1.x : ATA host aware zoned device

ATA device supporting the Host Aware Zones feature set (i.e., sets the ZONED field to 01b in the Supported Capabilities page of the IDENTIFY DEVICE data log (see ACS-4)).

3.1.y : ATA host managed zoned device

ATA device presenting the signature of a host managed device and supporting the Host Managed Zones feature set (see ACS-4).

7 Summary of SCSI / ATA command mappings

In the event of a discrepancy between the contents of this clause and the description of individual commands, description of individual commands shall apply.

Clause 7, clause 8, and clause 9 describe the SCSI to ATA command mapping for ATA devices emulating a SCSI logical unit with a peripheral device type of 00h (i.e., direct access block device) or 14h (i.e., host managed zoned device). Command transmission requirements for ATAPI devices are described in Annex A.

The SATL shall queue received SCSI commands as necessary to ensure the SATL does not send more than one ATA command to the ATA device representing the logical unit with the exception of ATA queued commands (see 3.1.23). Table 13 lists the SCSI / ATA command mappings defined in this standard. A SATL may implement commands defined in SPC-5⁴ and SBC-4³, but not listed in table 13. Translation of commands not listed in table 13 is vendor-specific.

Table 13 — Summary of SCSI / ATA command mapping (part 1 of 3)

| SCSI command | ATA command(s) ^a | Reference |
|---|---|-----------|
| ATA PASS-THROUGH (12) | Any | 12.2.2.2 |
| ATA PASS-THROUGH (16) | | 12.2.2.3 |
| CLOSE ZONE | CLOSE ZONE EXT command | 9.x |
| FINISH ZONE | FINISH ZONE EXT command | 9.x |
| FORMAT UNIT | READ VERIFY SECTORS, READ VERIFY SECTORS EXT, WRITE SECTORS, or WRITE SECTORS EXT | 9.2 |
| INQUIRY | IDENTIFY DEVICE | 8.1 |
| LOG SELECT | Log page dependent (see 10.2) | 8.2 |
| LOG SENSE | Log page dependent (see 10.2) | 8.3 |
| MODE SELECT (6) | Mode page dependent (see 10.1) | 8.4 |
| MODE SELECT (10) | | 8.5 |
| MODE SENSE (6) | | 8.6 |
| MODE SENSE (10) | | 8.7 |
| OPEN ZONE | OPEN ZONE EXT command | 9.x |
| READ (10) | See 9.x | 9.4 |
| READ (12) | | 9.5 |
| READ (16) | | 9.6 |
| READ BUFFER | READ BUFFER | 8.8 |
| ^a Translations for SCSI commands may require one or more of the ATA commands listed to be sent to the ATA device | | |

Table 13 — Summary of SCSI / ATA command mapping (part 2 of 3)

| SCSI command | ATA command(s) ^a | Reference |
|---|--|-----------|
| READ CAPACITY (10) | IDENTIFY DEVICE | 9.7 |
| READ CAPACITY (16) | | 9.w |
| REASSIGN BLOCKS | READ VERIFY SECTOR(S), READ VERIFY SECTOR(S) EXT, WRITE DMA, WRITE DMA EXT, WRITE DMA FUA EXT, WRITE DMA QUEUED, WRITE DMA QUEUED EXT, WRITE DMA QUEUED FUA EXT, or WRITE FPDMA QUEUED | |
| REPORT LUNS | n/a | SPC-4 |
| REPORT SUPPORTED OPERATION CODES | n/a | SPC-4 |
| REPORT TIMESTAMP | ATA read log command (see 3.1.26) | 8.9 |
| REPORT ZONES | REPORT ZONES EXT command | 9.x |
| REQUEST SENSE | SMART RETURN STATUS, CHECK POWER MODE, and SANITIZE STATUS EXT | 8.10 |
| RESET WRITE POINTER | RESET WRITE POINTER EXT command | 9.x |
| SANITIZE | SANITIZE DEVICE | 9.10 |
| SECURITY PROTOCOL IN | TRUSTED RECEIVE, TRUSTED RECEIVE DMA, or TRUSTED NON-DATA | 8.11 |
| SECURITY PROTOCOL OUT | TRUSTED SEND, TRUSTED SEND DMA, or TRUSTED NON-DATA | 8.12 |
| SEND DIAGNOSTIC | SMART EXECUTE OFF-LINE IMMEDIATE | 8.13 |
| SET TIMESTAMP | SET DATE & TIME EXT | 8.14 |
| START STOP UNIT | FLUSH CACHE, FLUSH CACHE EXT, STANDBY, IDLE IMMEDIATE, READ VERIFY SECTOR(S), READ VERIFY SECTOR(S) EXT, ATA verify commands, ATA flush commands, or STANDBY IMMEDIATE | 9.11 |
| SYNCHRONIZE CACHE (10) | FLUSH CACHE or FLUSH CACHE EXT | 9.12 |
| SYNCHRONIZE CACHE (16) | | 9.13 |
| TEST UNIT READY | CHECK POWER MODE and SANITIZE STATUS EXT | 8.15 |
| UNMAP | DATA SET MANAGEMENT | 9.14 |
| ^a Translations for SCSI commands may require one or more of the ATA commands listed to be sent to the ATA device | | |

Table 13 — Summary of SCSI / ATA command mapping (part 3 of 3)

| SCSI command | ATA command(s) ^a | Reference |
|---|---|-----------|
| VERIFY (10) | See 9.x | 9.15 |
| VERIFY (12) | | 9.16 |
| VERIFY (16) | | 9.17 |
| WRITE (10) | See 9.x | 9.19 |
| WRITE (12) | | 9.20 |
| WRITE (16) | | 9.21 |
| WRITE AND VERIFY (10) | See 9.x | 9.23 |
| WRITE AND VERIFY (12) | | 9.24 |
| WRITE AND VERIFY (16) | | 9.25 |
| WRITE BUFFER | WRITE BUFFER, DOWNLOAD MICROCODE, or DOWNLOAD MICROCODE DMA | 8.16 |
| WRITE LONG (10) | WRITE UNCORRECTABLE EXT | 9.26 |
| WRITE LONG (16) | | 9.27 |
| WRITE SAME (10) | See 9.x | 9.28 |
| WRITE SAME (16) | | 9.29 |
| ^a Translations for SCSI commands may require one or more of the ATA commands listed to be sent to the ATA device | | |

8 SCSI Primary Commands (SPC) command mapping

8.1 INQUIRY command

8.1.1 INQUIRY command overview

The INQUIRY command requests general information about a logical unit and target device. The INQUIRY command and selected VPD pages shall be emulated using information from the ATA IDENTIFY DEVICE command and other information (see 8.1.2). The SATL shall send an ATA IDENTIFY DEVICE command to the ATA device. Table 14 describes the emulation of fields in the INQUIRY CDB.

Table 14 — INQUIRY CDB field translations

| Field | Description or reference |
|--|---|
| OPERATION CODE | Set to 12h. |
| EVPD | Unspecified.(see 3.4.2). |
| PAGE CODE ^a | <p>The SATL:</p> <ul style="list-style-type: none"> a) shall support the Supported VPD Pages VPD page (00h) (see 10.3.2); b) may support the Unit Serial Number VPD page (80h) (see 10.3.7); c) shall support the Device Identification VPD page (83h) (see 10.3.4); d) should support the Mode Page Policy VPD page (87h) (see 10.3.5); e) shall support the ATA Information VPD page (89h) (see 12.4.2); f) may support the Power Condition VPD page (8Ah) (see 10.3.6); g) may support the Block Limits VPD page (B0h) (see 10.3.8); h) may support the Block Device Characteristics VPD page (B1h) (see 10.3.7); and i) may support the Logical Block Provisioning VPD page (B2h) (see 10.3.9); and j) may support the Zoned Block Device Characteristics VPD page (B6h) (see ZBC). |
| ALLOCATION LENGTH | Unspecified.(see 3.4.2). |
| CONTROL | 6.5 |
| ^a VPD page translations are defined in 10.3 and 12.4.2. | |

8.1.2 Standard INQUIRY data

Table 15 describes the standard INQUIRY data fields supported by the SATL.

Table 15 — Standard INQUIRY data fields (part 1 of 3)

| Field | Description or reference |
|---|---|
| PERIPHERAL QUALIFIER | The SATL shall set this field to 000b to indicate that the peripheral device is currently connected to this logical unit. ^a |
| PERIPHERAL DEVICE TYPE | <u>If the device is an ATA host managed zoned device (see 3.1.y), the SATL shall set this field to 14h to indicate this. Otherwise,</u> the SATL shall set this field to 00h to indicate that the peripheral device is a direct access block device. ^a |
| RMB | Unspecified (see 3.4.2) |
| VERSION | The VERSION field indicates the version of SPC to which the SATL complies (see SPC-4) (e.g., 06h for SPC-4). |
| NORMACA | The SATL shall set this bit to zero to indicate the SATL does not support the NACA bit in the CONTROL byte (see 6.5). |
| HiSUP | Unspecified (see 3.4.2) |
| RESPONSE DATA FORMAT | The SATL shall set this field to 2h. |
| ADDITIONAL LENGTH | The SATL shall set this field to the length of the INQUIRY data that follows. |
| SCCS | Unspecified (see 3.4.2) |
| ACC | Unspecified (see 3.4.2) |
| TPGS | Unspecified (see 3.4.2) |
| 3PC | Unspecified (see 3.4.2) |
| PROTECT | Unspecified (see 3.4.2) |
| ENC SERV | Unspecified (see 3.4.2) |
| VS | Unspecified (see 3.4.2) |
| MULTIP | Unspecified (see 3.4.2) |
| ADDR16 | Unspecified (see 3.4.2) |
| WBUS16 | Unspecified (see 3.4.2) |
| ^a If the INQUIRY command is sent to an incorrect logical unit then the SATL shall set the PERIPHERAL QUALIFIER field to 011b and shall set the PERIPHERAL DEVICE TYPE field to 1Fh. ^b See 3.5.4. ^c The full ATA IDENTIFY DEVICE data Model number field contents and the Firmware revision field contents are returned in the ATA Information VPD page (see 12.4.2). ^d The encoding used by the SPC-4 standard for INQUIRY version descriptors and the encoding used by the ACS-3 standard for ATA IDENTIFY DEVICE major and minor version numbers differ. The two standards may not define values for the same revisions. | |

Table 15 — Standard INQUIRY data fields (part 2 of 3)

| Field | Description or reference |
|-------------------------------------|--|
| SYNC | Unspecified (see 3.4.2) |
| CMDQUE | Unspecified (see 3.4.2) |
| T10 VENDOR IDENTIFICATION | The SATL shall set the T10 VENDOR IDENTIFICATION field to 'ATA' ^b . |
| PRODUCT IDENTIFICATION ^c | <p>The SATL shall set the PRODUCT IDENTIFICATION field to a representation of the first 16 bytes of the ATA IDENTIFY DEVICE data Model number field, where each pair of bytes are swapped to create a valid ASCII string format:</p> <ol style="list-style-type: none"> 1) byte 0 contains ATA IDENTIFY DEVICE word 27 bits 15:8 (i.e., byte 1); 2) byte 1 contains ATA IDENTIFY DEVICE word 27 bits 7:0 (i.e., byte 0); 3) byte 2 contains ATA IDENTIFY DEVICE word 28 bits 15:8 (i.e., byte 3); 4) byte 3 contains ATA IDENTIFY DEVICE word 28 bits 7:0 (i.e., byte 2); <p>...</p> <ol style="list-style-type: none"> 1) byte 14 contains ATA IDENTIFY DEVICE word 34 bits 15:8 (i.e., byte 15); and 2) byte 15 contains ATA IDENTIFY DEVICE word 34 bits 7:0 (i.e., byte 14). |
| PRODUCT REVISION LEVEL ^c | <p>The SATL shall set the PRODUCT REVISION LEVEL field to a four byte ASCII character representation of the ATA IDENTIFY DEVICE data Firmware revision field. Each pair of bytes are swapped to create a valid ASCII string format. Since the ATA IDENTIFY DEVICE data Firmware revision field contains eight ASCII characters and the standard INQUIRY data PRODUCT REVISION LEVEL field is four ASCII characters, the SATL shall select four of the eight ASCII characters from the ATA IDENTIFY DEVICE data Firmware revision field to return in the PRODUCT REVISION LEVEL field as follows:</p> <ol style="list-style-type: none"> a) If the ATA IDENTIFY DEVICE data words 25 to 26 are set to four ASCII spaces (i.e., 2020_2020h), then the four ASCII characters selected shall contain: <ol style="list-style-type: none"> 1) byte 0 contains ATA IDENTIFY DEVICE data word 23 bits 15:8 (i.e., byte 1); 2) byte 1 contains ATA IDENTIFY DEVICE data word 23 bits 7:0 (i.e., byte 0); 3) byte 2 contains ATA IDENTIFY DEVICE data word 24 bits 15:8 (i.e., byte 3); and 4) byte 3 contains ATA IDENTIFY DEVICE data word 24 bits 7:0 (i.e., byte 2); <p>or</p> <ol style="list-style-type: none"> b) If the ATA IDENTIFY DEVICE data words 25 to 26 are not set to four ASCII spaces (i.e., 2020_2020h), then the four ASCII characters selected shall contain: <ol style="list-style-type: none"> 5) byte 0 contains ATA IDENTIFY DEVICE data word 25 bits 15:8 (i.e., byte 5); 6) byte 1 contains ATA IDENTIFY DEVICE data word 25 bits 7:0 (i.e., byte 4); 7) byte 2 contains ATA IDENTIFY DEVICE data word 26 bits 15:8 (i.e., byte 7); and 8) byte 3 contains ATA IDENTIFY DEVICE data word 26 bits 7:0 (i.e., byte 6). |
| CLOCKING | Unspecified (see 3.4.2) |

^a If the INQUIRY command is sent to an incorrect logical unit then the SATL shall set the PERIPHERAL QUALIFIER field to 011b and shall set the PERIPHERAL DEVICE TYPE field to 1Fh.

^b See 3.5.4.

^c The full ATA IDENTIFY DEVICE data Model number field contents and the Firmware revision field contents are returned in the ATA Information VPD page (see 12.4.2).

^d The encoding used by the SPC-4 standard for INQUIRY version descriptors and the encoding used by the ACS-3 standard for ATA IDENTIFY DEVICE major and minor version numbers differ. The two standards may not define values for the same revisions.

Table 15 — Standard INQUIRY data fields (part 3 of 3)

| Field | Description or reference |
|--|--|
| QAS | Unspecified (see 3.4.2) |
| IUS | Unspecified (see 3.4.2) |
| VERSION DESCRIPTOR 1 to VERSION DESCRIPTOR 8 | <p>The SATL shall include version descriptors (see SPC-54) for:</p> <ul style="list-style-type: none"> a) the SCSI Architecture Model standard (e.g., SAM-5); b) this standard; c) the SCSI Primary Commands standard (e.g., SPC-54); d) the SCSI Block Commands standard (e.g., SBC-43); e) <u>the SCSI Zoned Block Commands standard (e.g., ZBC) if appropriate.</u> f) if the SATL receives SCSI commands through a SCSI target port (see figure 6 in 5.1), the version of the transport protocol to which the SCSI target port was designed; g) if the SATL sends ATA commands through a SAS STP initiator port (see figure 8 in 5.1), the version of SAS (e.g., SPL-3AS-2) to which the SAS STP initiator port was designed; and h) the version(s) of ATA standards (e.g., ACS-43 and ATA8-AAM) to which the ATA device claims compliance in <ul style="list-style-type: none"> A) ATA IDENTIFY DEVICE data word 80 (i.e., Major version number), B) ATA IDENTIFY DEVICE data word 81 (i.e., Minor version number), C) ATA IDENTIFY DEVICE data word 222, and D) ATA IDENTIFY DEVICE data word 223.^d |
| Vendor specific parameters | Unspecified (see 3.4.2) |
| <p>^a If the INQUIRY command is sent to an incorrect logical unit then the SATL shall set the PERIPHERAL QUALIFIER field to 011b and shall set the PERIPHERAL DEVICE TYPE field to 1Fh.</p> <p>^b See 3.5.4.</p> <p>^c The full ATA IDENTIFY DEVICE data Model number field contents and the Firmware revision field contents are returned in the ATA Information VPD page (see 12.4.2).</p> <p>^d The encoding used by the SPC-4 standard for INQUIRY version descriptors and the encoding used by the ACS-3 standard for ATA IDENTIFY DEVICE major and minor version numbers differ. The two standards may not define values for the same revisions.</p> | |

9 SCSI Block Commands (SBC) command mapping

9.x CLOSE ZONE command

9.x.1 CLOSE ZONE command overview

The CLOSE ZONE command ~~initiates a close zone operation (see ZBC) on~~ closes the zone or zones identified by the ZONE ID and ALL fields of the CDB. This command is applicable to ATA host aware zoned devices (see 3.1.x) and ATA host managed zoned devices (see 3.1.y). Table 47 shows the translation for fields in the CLOSE ZONE CDB.

Table 47 — CLOSE ZONE CDB field translations

| <u>Field</u> | <u>Description or reference</u> |
|-----------------------|---|
| <u>OPERATION CODE</u> | <u>Set to 94h.</u> |
| <u>SERVICE ACTION</u> | <u>Set to 01h</u> |
| <u>ZONE ID</u> | <u>If the SATL implements direct logical block mapping (see 3.1.42), then the SATL shall set the ZONE ID field in the ATA CLOSE ZONE EXT command equal to the value specified in the ZONE ID field. Otherwise, the mapping is unspecified (see 3.4.2). Unspecified (see 3.4.2)</u> |
| <u>ALL</u> | Unspecified (see 3.4.2) <u>9.x.2</u> |
| <u>CONTROL</u> | <u>6.5</u> |

9.x.2 CLOSE ZONE command processing

The SATL shall issue an ATA CLOSE ZONE EXT command (see ZAC).

If the SATL implements direct logical block mapping, and if the ALL bit is set to zero, the zone to be closed is identified by the ZONE ID field in the CDB. If the SATL does not implement direct logical block mapping, and if the ALL bit is set to zero, identification of the zone to be closed is unspecified.

If the ALL bit is set to one, the SATL shall issue the ATA CLOSE ZONE EXT command with the CLOSE_ALL bit set to one. The ZONE_ID field is ignored.

9.y FINISH ZONE command

9.y.1 FINISH ZONE command overview

The FINSH ZONE command finishes ~~initiates a finish zone operation (see ZBC) on~~ the zone or zones identified by the ZONE ID and ALL fields of the CDB. This command is applicable to ATA host aware zoned devices (see 3.1.x) and ATA host managed zoned devices (see 3.1.y). Table 48 shows the translation for fields in the FINISH

ZONE CDB.

Table 48 — FINISH ZONE CDB field translations

| <u>Field</u> | <u>Description or reference</u> |
|-----------------------|--|
| <u>OPERATION CODE</u> | <u>Set to 94h.</u> |
| <u>SERVICE ACTION</u> | <u>Set to 02h</u> |
| <u>ZONE ID</u> | <u>If the SATL implements direct logical block mapping (see 3.1.42), then the SATL shall set the ZONE ID field in the ATA FINISH ZONE EXT command equal to the value specified in the ZONE ID field. Otherwise, the mapping is unspecified (see 3.4.2).</u> Unspecified (see 3.4.2) |
| <u>ALL</u> | Unspecified (see 3.4.2) <u>9.y.2</u> |
| <u>CONTROL</u> | <u>6.5</u> |

9.y.2 FINISH ZONE command processing

The SATL shall issue an ~~ATA~~ FINISH ZONE EXT command (see ZAC).

If the SATL implements direct logical block mapping, and if the ALL bit is set to zero, the zone to be finished is identified by the ZONE ID field in the CDB. If the SATL does not implement direct logical block mapping, and if the ALL bit is set to zero, identification of the zone to be finished is unspecified.

If the ALL bit is set to one, the SATL shall issue the ATA FINISH ZONE EXT command with the FINISH_ALL BIT set to one. The ZONE_ID field is ignored.

9.z OPEN ZONE command**9.z.1 OPEN ZONE command overview**

The OPEN ZONE command opens ~~initiates an open zone operation (see ZBC) on~~ the zone or zones whose identity is specified by the ZONE ID and ALL fields of the CDB. This command is applicable to ATA host aware zoned devices (see 3.1.x) and ATA host managed zoned devices (see 3.1.y). Table 49 shows the translation for fields in the OPEN ZONE CDB.

Table 49 — OPEN ZONE CDB field translations

| <u>Field</u> | <u>Description or reference</u> |
|-----------------------|--|
| <u>OPERATION CODE</u> | <u>Set to 94h.</u> |
| <u>SERVICE ACTION</u> | <u>Set to 03h</u> |
| <u>ZONE ID</u> | <u>If the SATL implements direct logical block mapping (see 3.1.42), then the SATL shall set the ZONE ID field in the ATA OPEN ZONE EXT command equal to the value specified in the ZONE ID field. Otherwise, the mapping is unspecified (see 3.4.2).</u> Unspecified (see 3.4.2) |
| <u>ALL</u> | <u>Unspecified (see 3.4.2)</u> |
| <u>CONTROL</u> | <u>6.5</u> |

9.z.2 OPEN ZONE command processing

The SATL shall issue an ~~ATA~~ OPEN ZONE EXT command (see ZAC).

If the SATL implements direct logical block mapping, and if the ALL bit is set to zero, the zone to be closed is identified by the ZONE ID field in the CDB. If the SATL does not implement direct logical block mapping, and if the ALL bit is set to zero, identification of the zone to be opened is unspecified.

if the ALL bit is set to one, the SATL shall issue the ATA OPEN ZONE EXT command with the OPEN_ALL bit set to one in the command. The contents of the ZONE ID field is ignored.;

9.w REPORT ZONES command

9.w.1 REPORT ZONES command overview

The REPORT ZONES command returns parameter data that returns the identifiers and attributes of a selected set of zones (see ZBC) on the device. This command is applicable to ATA host aware zoned devices (see 3.1.x) and ATA host managed zoned devices (see 3.1.y). Table 50 shows the translation for fields in the REPORT ~~CLOSE~~ ZONES CDB.

Table 50 — REPORT ZONES field translations

| <u>Field</u> | <u>Description or reference</u> |
|--------------------------|---|
| <u>OPERATION CODE</u> | <u>Set to 95h.</u> |
| <u>SERVICE ACTION</u> | <u>Set to 00h</u> |
| <u>ZONE START LBA</u> | <u>If the SATL implements direct logical block mapping (see 3.1.42), then the SATL shall set the ZONE START LBA field in the ATA REPORT ZONES EXT command equal to the value specified in the ZONE START LBA field. Otherwise, the mapping is unspecified (see 3.4.2). Unspecified (see 3.4.2)</u> |
| <u>ALLOCATION LENGTH</u> | Unspecified (see 3.4.2). 9.w.3 |
| <u>REPORTING OPTIONS</u> | <u>The SATL shall set the REPORTING OPTIONS field of the ATA REPORT ZONES EXT command to the value specified in the REPORTING OPTIONS field. Unspecified (see 3.4.2)</u> |
| <u>CONTROL</u> | <u>6.5</u> |

9.w.2 REPORT ZONES command

The SATL shall issue an ATA REPORT ZONES EXT command (see ZAC).

If the SATL ~~device~~ implements direct logical block mapping, the ZONE START LBA field identifies the starting zone to be reported. If the device does not implement direct logical block mapping, the zones to be reported are unspecified.

~~The translation of the REPORTING OPTIONS field is specified in table 51.~~

9.23.3 ALLOCATION LENGTH field

The SATL shall issue the ATA REPORT ZONES EXT command with the COUNT field set to (ALLOCATION_LENGTH + 511)/512.

Table 51 — **REPORTING OPTIONS translation**

| <u>SCSI code</u> | <u>ATA code</u> | <u>Description or reference</u> |
|------------------|-----------------|--|
| <u>00h</u> | <u>00h</u> | <u>List all of the zones in the zoned block device.</u> |
| <u>01h</u> | <u>01h</u> | <u>List the empty zones (i.e., the zone condition for the zone is EMPTY (see ZBC)).</u> |
| <u>02h</u> | <u>02h</u> | <u>List the implicitly open zones (i.e., the zone condition for the zone is IMPLICIT OPEN (see ZBC)).</u> |
| <u>03h</u> | <u>03h</u> | <u>List the explicitly open zones (i.e., the zone condition for the zone is EXPLICIT OPEN (see ZBC)).</u> |
| <u>04h</u> | <u>04h</u> | <u>List the closed zones (i.e., the zone condition for the zone is CLOSED (see ZBC)).</u> |
| <u>05h</u> | <u>05h</u> | <u>List the full zones (i.e., the zone condition for the zone is FULL (see ZBC)).</u> |
| <u>06h</u> | <u>06h</u> | <u>List the read-only zones (i.e., the zone condition for the zone is READ-ONLY (see ZBC)).</u> |
| <u>07h</u> | <u>07h</u> | <u>List the offline zones (i.e., the zone condition for the zone is OFFLINE (see ZBC)).</u> |
| <u>08h-0Fh</u> | | <u>Reserved.</u> |
| <u>10h</u> | <u>10h</u> | <u>List the zones with the RESET bit set to one (see table 18).</u> |
| <u>11h</u> | <u>11h</u> | <u>List the zones with the NON_SEQ bit set to one (see table 18).</u> |
| <u>12h-3Eh</u> | | <u>Reserved.</u> |
| <u>3Fh</u> | <u>3Fh</u> | <u>List the zones that are not write pointer zones (i.e., the zone condition for the zone is NOT WRITE POINTER (see ZBC)).</u> |

9.w.4 REPORT ZONES parameter data

The REPORT ZONES parameter data is defined in table 52

Table 52 — REPORT ZONES parameter data

| <u>FIELD OR BIT</u> | <u>Description or reference</u> |
|--------------------------|---|
| <u>ZONE LIST LENGTH</u> | <u>Unspecified (see 3.4.2)</u> This field shall contain the contents of the zone list length field in the ATA Report Zones descriptor. |
| <u>SAME</u> | If the SATL implements direct logical block mapping (see 3.1.47), then this field shall contain the contents of the SAME field in the ATA Report Zones descriptor. Otherwise, this is unspecified (see 3.4.2) |
| <u>MAXIMUM LBA</u> | If the SATL implements direct logical block mapping (see 3.1.47), then this field shall contain the ATA maximum LBA (see 3.1.20). If the SATL implements indirect logical block mapping, then this field is unspecified (see 3.4.2). |
| <u>ZONE TYPE</u> | If the SATL implements direct logical block mapping, this shall contain contains the mapped value (from table 55) of the contents of the ZONE TYPE field of the ATA Report Zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2) |
| <u>ZONE CONDITION</u> | If the SATL implements direct logical block mapping, this shall contain contains the mapped value (from table 56) of the contents of the ZONE CONDITION field from the ATA Report Zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2) |
| <u>NON_SEQ</u> | If the SATL implements direct logical block mapping, this shall contain contains the contents of the NON_SEQ field from the ATA Report zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2) |
| <u>RESET</u> | If the SATL implements direct logical block mapping, this shall contain contains the contents of the RESET field from the ATA Report Zones descriptor for the identified zone (see ZAC). If the SATL implements indirect logical block mapping (see 3.1.52), then this field is unspecified (see 3.4.2). |
| <u>ZONE LENGTH</u> | If the SATL implements direct logical block mapping, this shall contain contains the contents of the ZONE LENGTH field from the ATA Report Zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2) |
| <u>ZONE START LBA</u> | If the SATL implements direct logical block mapping, this shall contain contains the contents of the ZONE START LBA field from the ATA Report Zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2) |
| <u>WRITE POINTER LBA</u> | If the SATL implements direct logical block mapping, this shall contain contains the contents of the WRITE POINTER LBA field from the ATA Report Zones descriptor for the identified zone (see ZAC). If the SATL implements indirect logical block mapping, then this field is unspecified. |

Table 53 — ZONE TYPE translation

| <u>ATA code</u> | <u>SCSI code</u> | <u>Description or reference</u> |
|-------------------|------------------|--|
| <u>01h</u> | <u>01h</u> | <u>Conventional zone (see ZBC)</u> |
| <u>02h</u> | <u>02h</u> | <u>Sequential Write Preferred zone (see ZBC)</u> |
| <u>03h</u> | <u>03h</u> | <u>Sequential Write Required zone (see ZBC))</u> |
| <u>All others</u> | | <u>Reserved</u> |

Table 54 — ZONE CONDITION translation

| <u>ATA code</u> | <u>SCSI code</u> | <u>Description or reference</u> |
|-------------------|------------------|------------------------------------|
| <u>00h</u> | <u>00h</u> | <u>NOT WRITE POINTER (see ZBC)</u> |
| <u>01h</u> | <u>01h</u> | <u>EMPTY (see ZBC)</u> |
| <u>02h</u> | <u>02h</u> | <u>IMPLICIT OPEN (see ZBC))</u> |
| <u>03h</u> | <u>03h</u> | <u>EXPLICIT OPEN (see ZBC))</u> |
| <u>04h</u> | <u>04h</u> | <u>CLOSED (see ZBC))</u> |
| <u>0Dh</u> | <u>0D</u> | <u>READ ONLY (see ZBC))</u> |
| <u>0Eh</u> | <u>0Eh</u> | <u>FULL (see ZBC))</u> |
| <u>0Fh</u> | <u>0Fh</u> | <u>OFFLINE (see ZBC)</u> |
| <u>All others</u> | | <u>Reserved</u> |

The number of bytes returned shall be the smaller of (ZONE LIST LENGTH + 64) and the contents of the ALLOCATION LENGTH field in the request.

9.v RESET WRITE POINTER command

9.v.1 RESET WRITE POINTER command overview

The RESET WRITE POINTER command resets the write pointer (see ZBC) in the zone or zones identified by the ZONE ID and ALL fields of the CDB. This command is applicable to ATA host aware zoned devices (see 3.1.x) or ATA host managed zoned devices (see 3.1.y). Table 55 shows the translation for fields in the RESET WRITE

POINTER CDB.**Table 55 —** RESET WRITE POINTER field translations

| <u>Field</u> | <u>Description or reference</u> |
|-----------------------|--|
| <u>OPERATION CODE</u> | <u>Set to 94h.</u> |
| <u>SERVICE ACTION</u> | <u>Set to 04h</u> |
| <u>ZONE ID</u> | <u>If the SATL implements direct logical block mapping (see 3.1.42), then the SATL shall set the ZONE ID field in the ATA RESET WRITE POINTER EXT command equal to the value specified in the ZONE ID field. Otherwise, the mapping is unspecified (see 3.4.2).</u> Unspecified (see 3.4.2) |
| <u>ALL</u> | Unspecified (see 3.4.2) <u>9.v.2</u> |
| <u>CONTROL</u> | <u>6.5</u> |

9.v.2 RESET WRITE POINTER command

The SATL shall issue an ATA RESET WRITE POINTER EXT command (see ZAC). If the SATL implements direct logical block mapping, and if the ALL BIT is set to zero, the zone is identified by the ZONE ID field in the CDB. If the SATL does not implement direct logical block mapping, and if the ALL bit is set to zero, identification of the zone whose write pointer is reset is unspecified.

If the ALL bit is set to one, the SATL shall issue the ATA RESET WRITE POINTER EXT command with the RESET_ALL bit set to one. The contents of the ZONE ID field are ignored.

10 Parameters for SAT implementations

10.3 Vital product data parameters

10.3.1 Vital product data parameters overview

Table 84 provides a summary of the VPD page translations defined in this standard.

Table 84 — Summary of SCSI / ATA VPD page mapping

| SCSI VPD page | Reference |
|---|---|
| Supported VPD Pages VPD page (i.e., 00h) | 10.3.2 |
| Unit Serial Number VPD page (i.e., 80h) | 10.3.7 |
| Device Identification VPD page (i.e., 83h) | 10.3.4 |
| Mode Page Policy VPD page (i.e., 87h) | 10.3.5 |
| ATA Information VPD page (i.e., 89h) | 12.4.2 |
| Power Condition VPD page (i.e., 8Ah) | 10.3.6 |
| Block Limits VPD page (i.e., B0h) | 10.3.8 |
| Block Device Characteristics VPD page (i.e., B1h) | 10.3.7 |
| Thin Provisioning VPD page (i.e., B2h) | 10.3.9 |
| Zoned Block Device Characteristics VPD page (i.e., B6h) | 10.3.x |
| All others | See SPC-4 and SBC-3 Unspecified (see 3.4.2) |

10.3.2 Supported VPD Pages VPD page

Table 85 shows the fields of the Supported VPD Pages VPD page.

Table 85 — Supported VPD Pages VPD page fields

| Field | Description or reference |
|-------------------------|--|
| PERIPHERAL QUALIFIER | The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2. |
| PERIPHERAL DEVICE TYPE | |
| PAGE CODE | The SATL shall set this field to 00h. |
| PAGE LENGTH | The SATL shall set this field to indicate the length of the supported VPD page list returned in number of bytes. |
| Supported VPD page list | Unspecified (see 3.4.2). |

10.3.7 Block Device Characteristics VPD page

Table 86 shows the translation of fields in the Block Device Characteristics VPD page.

Table 86 — Block Device Characteristics VPD page field translations

| Field | Description or Reference |
|------------------------|--|
| PERIPHERAL QUALIFIER | The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2. |
| PERIPHERAL DEVICE TYPE | |
| PAGE CODE | Shall be set to B1h. |
| PAGE LENGTH | Shall be set to 003Ch. |
| MEDIUM ROTATION RATE | The SATL shall set this field to the value contained in the ATA IDENTIFY DEVICE data word 217. |
| PRODUCT TYPE | Shall be set to 00h. |
| WABEREQ | Unspecified (see 3.4.2) |
| WACEREQ | Unspecified (see 3.4.2) |
| NOMINAL FORM FACTOR | The SATL shall set this field to the value contained in the ATA IDENTIFY DEVICE data word 168 bits 3:0. |
| ZONED | The SATL shall set this field to one if the device is either an ATA host aware zoned device (see 3.1.x) or an ATA host managed zoned device (see 3.1.y) The SATL shall set this field to the value of the Zoned Capabilities field of ATA IDENTIFY DEVICE data . |
| FUAB | Unspecified (see 3.4.2) |
| VBULS | Unspecified (see 3.4.2) |

10.3.x Zoned Block Device Characteristics VPD page

Table x shows the translation of fields in the Zoned Block Device Characteristics VPD page. This page shall be supported if the device is either an ATA host aware zoned device (see 3.1.x) or an ATA host managed zoned device (see 3.1.y)

Table x — Zoned Block Device Characteristics VPD page field translations

| <u>Field</u> | <u>Description or Reference</u> |
|--|---|
| PERIPHERAL QUALIFIER | The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2. |
| PERIPHERAL DEVICE TYPE | |
| PAGE CODE | Shall be set to B6h. |
| PAGE LENGTH | Shall be set to 003Ch. |

Table x — Zoned Block Device Characteristics VPD page field translations

| <u>Field</u> | <u>Description or Reference</u> |
|--|--|
| <u>URSWRZ</u> | Shall be set to the value of the URSWRZ field in the <u>Zoned Device Information page of the ATA IDENTIFY DEVICE log (see ZAC).</u> |
| <u>OPTIMAL NUMBER OF OPEN SEQUENTIAL WRITE PREFERRED ZONES</u> | Shall be set to the value of the OPTIMAL NUMBER OF OPEN SEQUENTIAL WRITE PREFERRED ZONES field in the <u>Zoned Device Information page of the ATA IDENTIFY DEVICE log (see ZAC).</u> |
| <u>OPTIMAL NUMBER OF NON-SEQUENTIALLY WRITTEN SEQUENTIAL WRITE PREFERRED ZONES</u> | Shall be set to the value of the OPTIMAL NUMBER OF NON-SEQUENTIALLY WRITTEN SEQUENTIAL WRITE PREFERRED ZONES field in the <u>Zoned Device Information page of the ATA IDENTIFY DEVICE log (see ZAC).</u> |
| <u>MAXIMUM NUMBER OF OPEN SEQUENTIAL WRITE REQUIRED ZONES</u> | Shall be set to the value of the MAXIMUM NUMBER OF OPEN SEQUENTIAL WRITE REQUIRED ZONES field in the <u>Zoned Device Information page of the ATA IDENTIFY DEVICE log (see ZAC).</u> |

11 Translation of ATA errors to SCSI errors

11.1 Overview

Unless otherwise specified in the subclause describing the translation of a particular SCSI command, log page, mode page or VPD page, the SATL shall translate ATA commands that complete with an error to SCSI errors as shown in table 151.

Table 151 — ATA to SCSI Error Translation

| Command encountering an error | Feature settings | Reference |
|-------------------------------|--|-----------|
| ATA NCQ Command | ATA NCQ Autosense is supported (i.e., the NCQ AUTSENSE SUPPORTED bit is set to one in the ATA IDENTIFY DEVICE data log.) | 11.2 |
| | ATA NCQ Autosense is not supported (i.e., the NCQ AUTSENSE SUPPORTED bit is set to zero in the ATA IDENTIFY DEVICE data log.) | 11.3 |
| ATA non-NCQ command | a) ATA Sense Data Reporting feature set enabled (i.e., the SENSE DATA ENABLED bit in the ATA IDENTIFY DEVICE data log is set to one)(see 5.4); b) ATA Sense Data Available bit in the ATA Status field is set to one; and c) The ERR bit in the ATA Status field is set to one | 11.4 |
| | All others | 11.5 |

11.2 ATA NCQ autosense error translation

The SCSI SENSE KEY field shall be set to byte 14 of the ATA Queued Error log, the SCSI ADDITIONAL SENSE CODE field shall be set to byte 15, and the SCSI ADDITIONAL SENSE CODE QUALIFIER field shall be set to byte 16 for error reporting.

If the sense key indicates MEDIUM ERROR, or the additional sense code and additional sense code qualifier indicates

- a) READ BOUNDARY VIOLATION
- b) ATTEMPT TO READ INVALID DATA
- c) UNALIGNED WRITE COMMAND, or
- d) WRITE BOUNDARY VIOLATION, then

if presenting descriptor sense, the SATL shall include an information descriptor with the valid bit set to one, bytes [4:5] of the information descriptor set to zero, and bytes [6:11] of the information descriptor set to the value of LBA[47:0]; and if presenting fixed-format sense and LBA[47:32] is zero, the SATL shall include LBA[31:0] in bytes [3:6] of the fixed-format sense data (i.e., in the information field), and setting the valid bit to one.

11.3 ATA NCQ no autosense error translation

The SATL shall translate the error to the appropriate SCSI error using the translation described in 11.5 as if :

- a) the ATA Status field was set to the contents of byte two of the ATA Queued Error log; and
- b) the ATA Error field was set to the contents of byte three of the ATA Queued Error log.

11.4 ATA sense data available with ATA error translation

To translate an ATA error with sense data available, the SATL shall send an ATA REQUEST SENSE DATA EXT command to the ATA device.

If the ATA REQUEST SENSE DATA EXT command:

- a) completes without error, then the SATL shall set the SENSE KEY field to the value contained in ATA LBA field bits 19:16, ADDITIONAL SENSE CODE field to the value contained in ATA LBA field bits 15:8 and ADDITIONAL SENSE CODE QUALIFIER field to the value contained in ATA LBA field bits 7:0; or
- b) completes with error, then the SATL shall translate the original ATA device command error, as described in 11.5.

11.5 ATA Fixed error translation

The ATA Status field and Error field bit settings provide the information to be translated into SCSI sense key, additional sense code, and additional sense code qualifier for error reporting as shown in table 152.

Table 152 — Fixed Translation of ATA errors to SCSI errors

| ATA Error | | SCSI Error | |
|---|--------------------|------------------------------|---|
| Field | | | |
| Status | Error ^a | Sense key | Additional sense code |
| DF ^b | n/a | HARDWARE ERROR | INTERNAL TARGET FAILURE |
| ERR | NM | NOT READY | MEDIUM NOT PRESENT |
| ERR | UNC | MEDIUM ERROR | UNRECOVERED READ ERROR |
| ERR | WP | DATA PROTECT | WRITE PROTECTED |
| ERR | IDNF | ILLEGAL REQUEST ^d | LOGICAL BLOCK ADDRESS OUT OF RANGE ^d |
| <div>^a If the Error field has an obsolete bit set to one, then the SATL may return a vendor-specific additional sense code (e.g., if the AMNF bit is set to one, return a sense key of MEDIUM ERROR, with additional sense code of ADDRESS MARK NOT FOUND FOR DATA FIELD).</div> <div>^b After an ATA device returns a DF bit set to one, the SATL processes any subsequent commands received for the logical unit corresponding to the ATA device by terminating the command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to INTERNAL TARGET FAILURE.</div> <div>^c The ABRT bit is ignored if any other ATA error bit is set.</div> <div>^d SATLs compliant with versions of this standard prior to SAT-2 return a sense key of MEDIUM ERROR and an additional sense code of RECORD NOT FOUND.</div> | | | |

Table 152 — Fixed Translation of ATA errors to SCSI errors

| ATA Error | | SCSI Error | |
|-----------|--------------------|--|--|
| Field | | | |
| Status | Error ^a | Sense key | Additional sense code |
| ERR | ABRT _c | ABORTED COMMAND | NO ADDITIONAL SENSE INFORMATION |
| ERR | MC | UNIT ATTENTION | NOT READY TO READY CHANGE, MEDIUM MAY HAVE CHANGED |
| ERR | MCR | UNIT ATTENTION | OPERATOR MEDIUM REMOVAL REQUEST |
| ERR | ICRC | ABORTED COMMAND | INFORMATION UNIT iuCRC ERROR DETECTED |
| CORR | n/a | This condition is not considered an error. | |

^a If the Error field has an obsolete bit set to one, then the SATL may return a vendor-specific additional sense code (e.g., if the AMNF bit is set to one, return a sense key of MEDIUM ERROR, with additional sense code of ADDRESS MARK NOT FOUND FOR DATA FIELD).

^b After an ATA device returns a DF bit set to one, the SATL processes any subsequent commands received for the logical unit corresponding to the ATA device by terminating the command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to INTERNAL TARGET FAILURE.

^c The ABRT bit is ignored if any other ATA error bit is set.

^d SATLs compliant with versions of this standard prior to SAT-2 return a sense key of MEDIUM ERROR and an additional sense code of RECORD NOT FOUND.